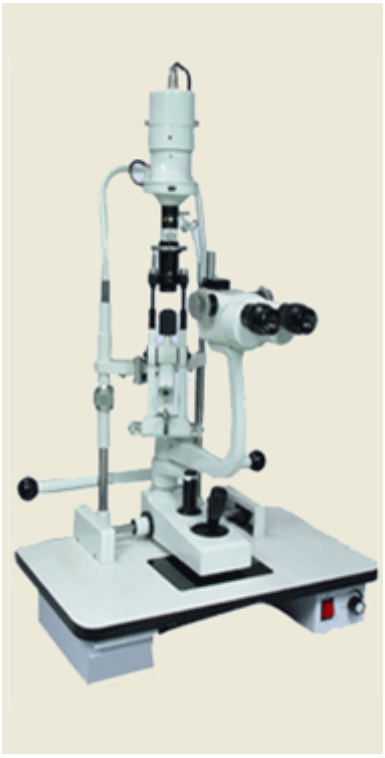
ZABBYS SLIT LAMP USER MANUAL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(AN ISO 9001:2008 CERTIFIED COMPANY, CE CERTIFIED PRODUCTS,ISO 13485:2003 , FDA APPROVED)

WARNINGS

1. Avoid flammable or explosive environments, dust, or high temperatures. For indoor use only. Keep the slit lamp clean and dry.
2. Check that all wires are correctly and firmly connected before using. Ensure that the instrument is well grounded.
3. Pay attention to all the rated values of the electrical connecting terminal.
4. Use only a fuse with the specifications and rated values stipulated by the product.
5. Use the supplied power cable with this instrument.
6. Do not touch the surface of the lens or prism with the hand or any hard object.
7. Turn off the main power first before replacing the illumination bulb and fuse.
8. To prevent the instrument from falling, it should be placed on a surface with an inclination angle of less than 10°.
9. Turn off the power and cover the instrument with a dust cover when not in use.
10. In case of a problem, please refer to the troubleshooting guide.

NOMENCLATURE

1. Joystick -- Incline joystick to move the instrument slightly on the horizontal surface and rotate it to adjust the elevation of the microscope.
2. Base Locking Screw -- Locks the base when fastened.
3. Rail Cover -- Protects the rail surface.
4. Base -- Supports the microscope and the illumination arms with the joystick.
5. Work Table
6. Accessory Drawer -- Storage for the focusing test rod and other accessories.
7. Brightness Control Switch -- Controls three levels of illumination – H (high), N (normal), and L (low) OR continuous variation depending on the model. Avoid working continuously at the high setting as the service life of the bulb will be shortened.
8. Main Power Switch
9. Pilot Lamp
10. Microscope Arm Locking Knob -- Locks the rotational movement of microscope arm.
11. Angle Mark Ring -- Marks the ring of the illumination arm (which relate to the long mark of the microscope) that represents the angle of the two arms.
12. Chin Rest Elevation Adjustment Knob -- Rotating the knob adjusts the elevation of the chin rest.
13. Location Roller -- When in the middle, it represents the included angle of 0° between the microscope arm and the illumination arm. When moved to the right or left, the angle is 10°.
14. Microscope and Illumination Arm Couple Bolt -- Fastening this bolt allows the illumination arm and the microscope arm to move and rotate together. When loosened, the illumination arm can be rotated separately.
15. Hruby Lens Guide Plate -- Can also be used as an assembly plate for the applanation tonometer.
16. Breath Shield (may depend on the model)
17. Chin Rest
18. Magnification Selection Dial or two step magnifier or zoom magnification depending on model taken – Turn to select the desired of two step, or five step five different magnifications of the microscope or zoom magnification with continuous zoom. (depends on the model taken)
19. Prism Box – Separate to adjust pupillary distance. (depending on model)
20. 12.5x Eyepiece
21. Microscope Fixation Screw

22. Applanation Tonometer Mount – Optional Applanation Tonometer mounts here (sold separately).
23. Horizontal Mark – This serves as a guide to ensure proper chin rest height for each patient. The patient's outer can thus should be level with this mark.
24. Forehead Strap
25. Diffusion Lens -- Used for enlarging illumination field (sold seperately and fixes in certain models only)
26. Lamp Cap
27. Slit Height and Aperture Display Window
28. Filter Selection Lever -- Switches before four filters.
29. Horizontal Mark -- When the patient's lateral canthus is in line with this mark, the elevation of the microscope is controlled by the joystick in the center position.
30. Fixation Target light -- fixation targets are available, the diopter adjustment target and the illuminated fixation spot.
31. Reflecting Mirror -- Both long and short reflecting mirrors are provided. The long mirror is routinely used for most examination procedures. The short mirror is used when the long mirror interferes with observation, such as during funduscopy.
32. Hruby Lens -- Used for observation of the fundus and the posterior segment of the vitreous body.
33. Hruby Lens Holder
34. Centering Knob -- Loosening this knob allows the illumination light to be moved from the center of the visual field for indirect retroillumination. Fastening the knob brings the illumination light back to the center.
35. Slit Width Control Knob -- The slit width is adjustable within the rage from 0 to 9mm. The marks on the left knob stand for the approximate width of the slit.

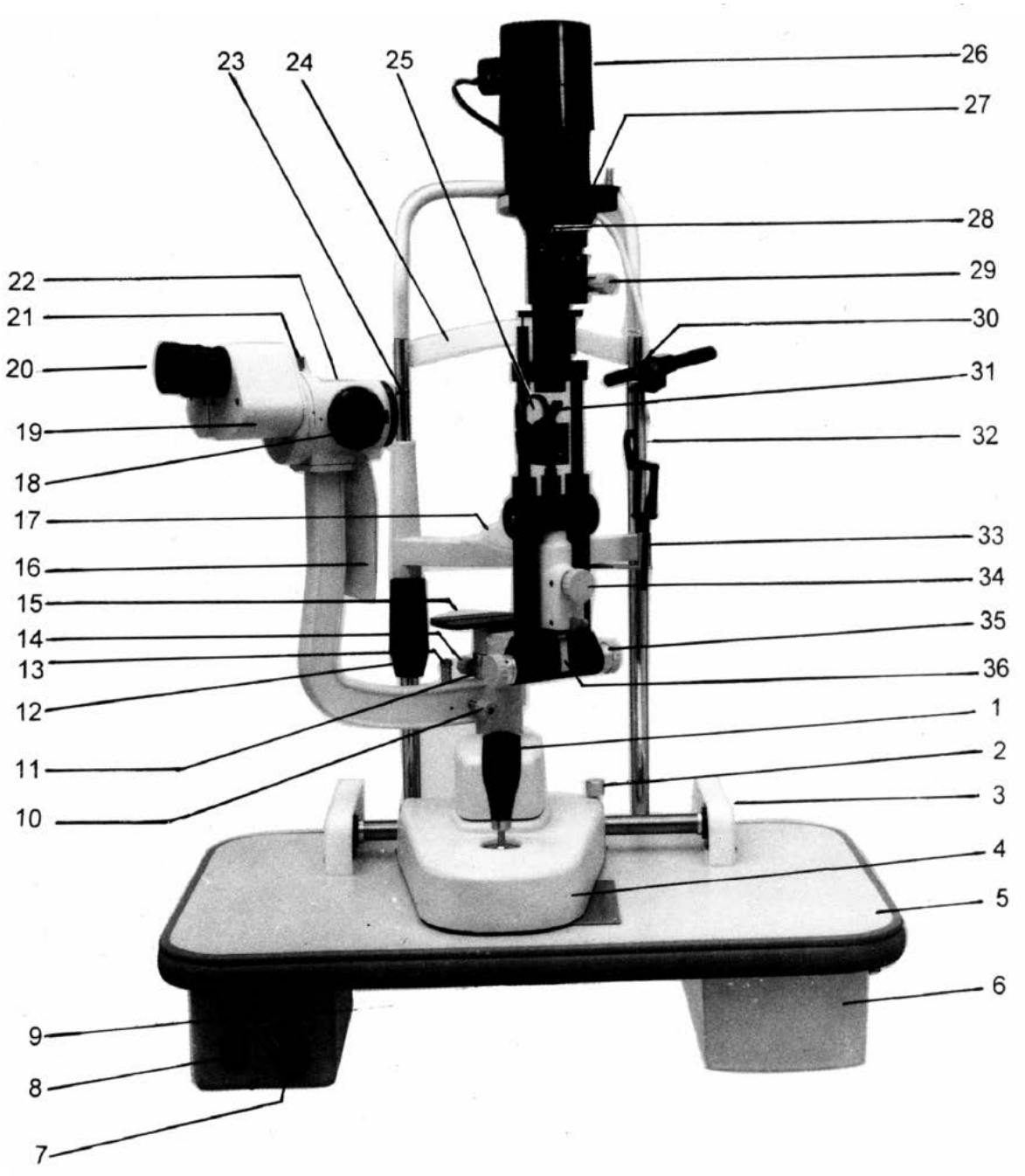


Figure 1

ASSEMBLY

This section of the manual describes how to assemble the slit lamp. All parts should be taken out of the packing case with great care before assembling.

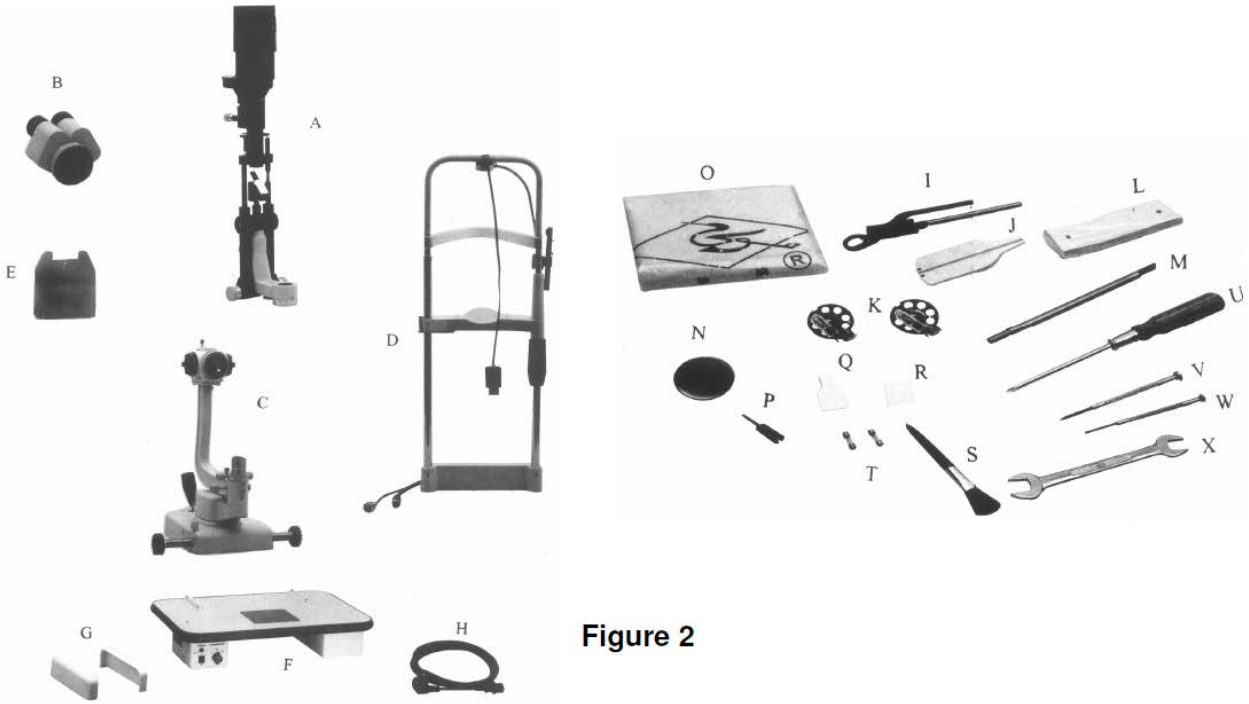


Figure 2

Assembly Procedure

Necessary tools for assembly: Phillips Screwdriver (U), Optical Screwdriver (V, W), and Wrench (X), Allen key

Selecting Voltage and Fuse

Check the setting on the voltage selector located on the bottom of the power box (Fig. 3). If it does not match with the input voltage, slide it to the proper position with screwdriver (V). Open the fuse holder with screwdriver (U) and take out the fuse. Ensure that its rated value is corresponding to the mains voltage 220V, 0.5A. It has been set to 220v before leaving the factory.

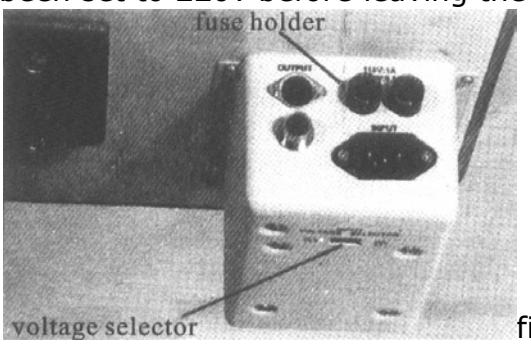


figure3

ATTENTION! Set the input voltage and frequency according to that of the mains.

Attaching the Worktable (F)

To attach the work table onto a motorized work table or exam lane arm, please screw off four or three 8x20mm with spring washers using the wrench (X). Lift the work table to aim its screw hold at the assembly hole of the instrument table. Put down the work table with the power panel facing the operator, and then refasten the bolts securely with wrench.

Assembling the Head Rest (D)

Remove four or three allen screws attached to the chin rest connection board with the allen key. Put two cables in the cap between the head rest fixation plate and the chin rest connection board(Fig. 4). While ensuring that they are not clamped, retighten the previously removed screws.

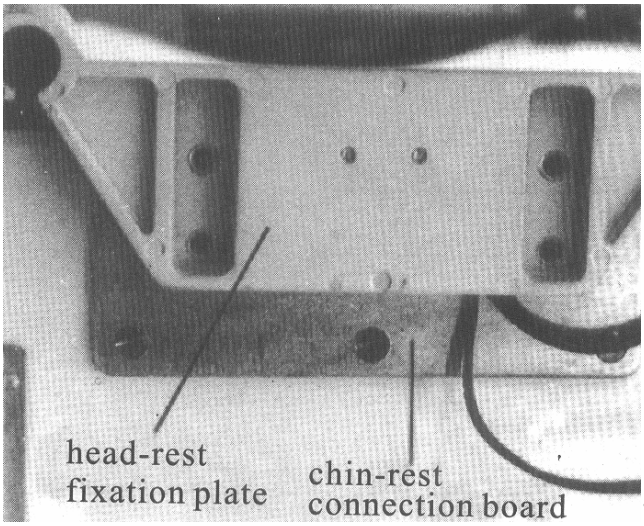


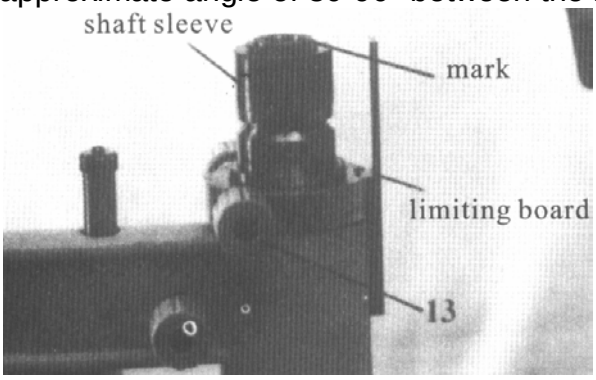
fig4

Assembling the Base Part (C) and the Rail Covers (G)

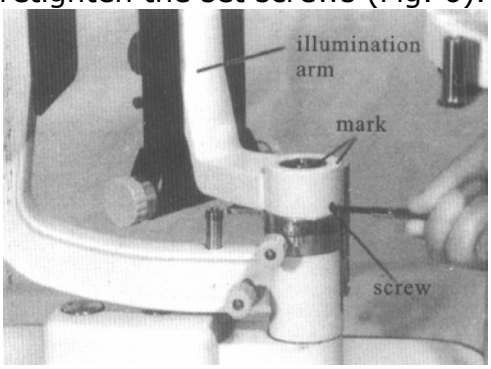
Place the wheels of both sides of the base (C) on the rail on the work table. Check whether the wheels can be rolled steadily on the rail. Remove four screws attached to the rail with the screwdriver (U). Place the rail cover (G) to the rail; retighten the previously removed screws.

Assembling Illumination Part (A)

Loosen the illumination arm couple bolt (14). Rotate the brass shaft sleeve to make an approximate angle of 30-90° between the red mark and the limiting board (Fig. 5).



Loosen the set screws in the illumination arm with the screwdriver (V) or screw provided with handle depending on model supplied. Aim the assembly hold of the illumination arm at the brass shaft sleeve with care, and then put it down. Keep the shaft close to the bottom surface well and check the back plate accurately aligned, retighten the set screws (Fig. 6).

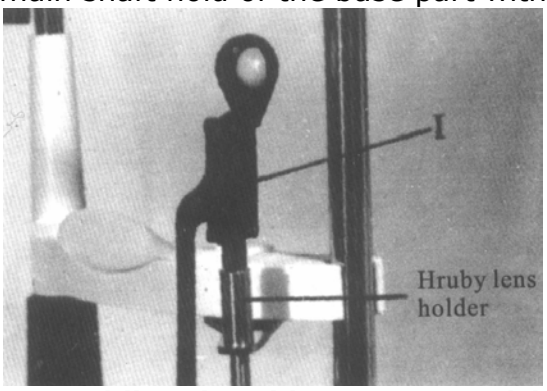


Connecting the Plug

Peel off the tape attached to the lamp cap, which ensures that the cap is tightened to the lamp base during shipping. Insert the plug on the top of the head rest part (D) into the socket of the lamp cap (26) on the illumination part (A). Connect the two plugs below the head rest part with the corresponding output socket of the power box. Insert the plug of the input power cable (H) into the input socket of the power box. Remove the cable clips from the bottom of the work table with screw driver (U) and wrap the output and input cables respectively, then reattach then to the bottom of the work table.

Assembling the Hruby Lens (I) and the Hruby Lens Guide Plate (J)

Insert the Hruby lens (I) into the Hruby lens holder (35) on the head rest. Be careful not to touch the lens surface (Fig. 8). Place the Hruby lens guide plate (J) into the main shaft hold of the base part with the small end pointing to the head rest.



Assembling the Chin Rest Paper (L)

Pull out the two fixing pins from the chin rest. Discard the paper package and allow the pins to go through the holes. Insert the fixing pins into the hole again. Replacement chin rest papers can be purchased from zabbys.

Storing Spare Parts

Some spare parts could be stored in the accessory drawer (6).

Checking Procedure After Assembling

Power Plug

This instrument supplies a three wire cable. Please select a proper power socket as matched.Ensure that the instrument is well grounded.

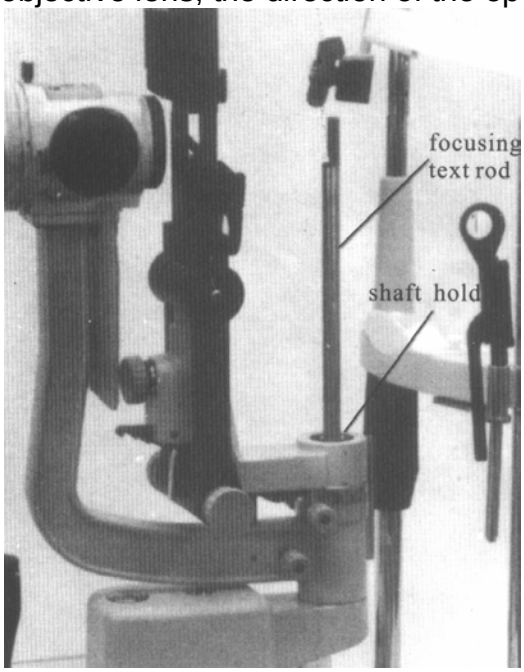
ATTENTION! Please use the special cable supplied with this instrument.

Power Box and Illumination Part

When the main power switch (8) of the power box is placed at 'I', it turns on, and at 'O' it turns off. The main power switch should be set at the 'O' position before connecting the input cable with the power socket. Turn off the main power switch, and the pilot lamp (9) will be lighted. Open the slit width control knob (35) to examine the illumination. Rotate the brightness control switch (7) respectively at three positions and the brightness should be changed accordingly.

Check the fixation target device to confirm it is lighting. Check whether all the moveable parts such as aperture and slit height control knob (29), filter selection lever (28), and magnification lever (18) etc. could be operated freely. After examining, turn off the main power and cover the instrument with the dust proof cover (O).

OPERATION PROCEDURES
Diopter Compensation and Pupil Distance Adjustment
Use of the Focusing Test Rod (M)
The rod is supplied as one of the standard accessories for confirming the microscope's accurate adjustment. Insert it into the main shaft hold with the flat surface facing the objective lens, the direction of the operator (Fig. 9).



Brightness Adjustment
Switch on the main power switch and set the brightness control switch (7) at 'N' or low position. Turn the slit width control knob (35) to make the slit width 2-3mm.
Diopter Compensation
The focus of the microscope is calibrated for an emmetropic user. If the operator has uncorrected refractive error, the eyepiece should be adjusted to the proper power.
To adjust the eyepieces:
- Rotate the diopter adjustment ring (19) counterclockwise all the way.
- Rotate the ring clockwise until a sharp slit image appears on the focusing text rod.
- Adjust the other eyepiece in the same manner.
- Record the diopter value on each eyepiece for future reference.

Pupil distance adjustment
Separate the prism box of the microscope with both hands to adjust the PD until both eyes can see the same image on the focusing test rod through the eyepieces. A stereo view will be seen.
ATTENTION! While adjusting the PD, ensure that both eyepieces are at the same height.

<u>Patient Position and Fixation Target</u>

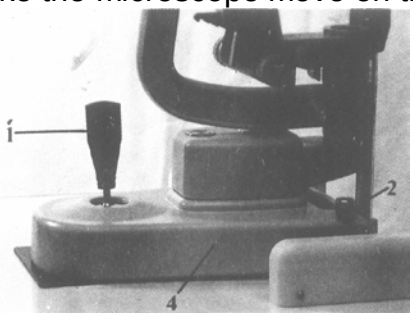
Positioning the Patient's Head
Have the patient place his chin on the chin rest (17) and his forehead against the head rest belt (24). Adjust the chin rest elevation adjustment knob (12) below the chin rest until the patient's canthus aligns with the horizontal mark (23).

Use of the Fixation Target
For fixing the patient's eyesight, instruct him to look at the fixation target (30). To change fixing position, move the lamp bar and move the curved lever around the forehead. The fixation target with diopter compensation supplies a dot and concentric circles target. Slide the knob to adjust the diopter compensation within the range of −15D to +10D. The fixation target with spot light is used for the patient whose refractive error exceeds −15D. When changing, loosen the fixation screw, replace the fixation target with the spot light source, and refasten with fixation screw.

Base Operation

Horizontal Rough Adjustment

Keep the joystick (1) erect and move the base (4) to make the microscope move on the horizontal surface to aim at the object roughly (Fig. 11).



Vertical Adjustment

Rotate the joystick to adjust the microscope height until it aligns with the target. Turn the joystick clockwise to raise the microscope and counterclockwise to lower it.

Horizontal Adjustment

Tilt the joystick to make the microscope move slightly on the horizontal surface. While looking through the eyepieces, tilt the joystick to aim accurately at the object for a sharp image.

Locking the Base

When finishing the adjustment, fasten the base locking screw (2) to lock the base (4) to prevent it from sliding.

Changing the Aperture and Slit Height

Changing the Slit Width

Turn the slit width control knob (35) and the slit width will be changed from 0 to 9mm. The slit becomes a circle at 9mm. The approximate width is indicated by the scale on the knob.

Changing the Aperture and Slit Height

Turn the aperture and slit height control knob (29) and six different circular beams of light are available at full aperture: 9, 8, 5, 3, 1, and 0.2 mm diameter. With a slit image, the slit height can be changed continuously from 1mm to 9mm, which is indicated through the display window (27).

Rotating the Slit Image

Swing the aperture and slit height control knob (29) horizontally to revolve the slit image at any angle in the vertical or horizontal direction. The angle of image rotation is indicated by the rotation angle scale with small division of 5° and big division of 10°.

Deflecting the Illumination Light
Loosen the centering knob (34) and swing the slit width control knob (35) back and forth so the light spot moves away from the center of the microscope vision field. It is mainly used to examine the eyes by indirect retroillumination. Fasten the centering knob and the slit light will return to the center of the microscope vision field (Fig. 12).

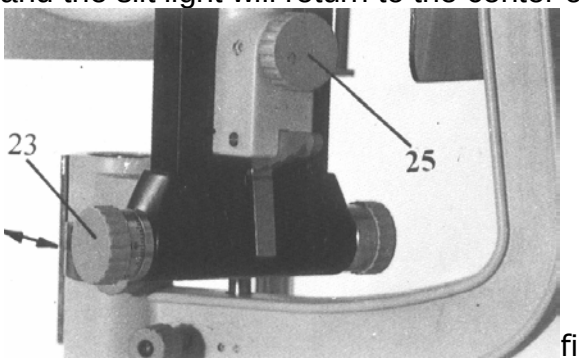


fig12

Oblique Illumination
This is used for sectional or fundus examination by using a contact lens. Press down the inclination lever (36) so that the illumination part inclines to 20° (5° of each division). Since the illumination part may touch the patient's head, operate carefully (Fig. 13).

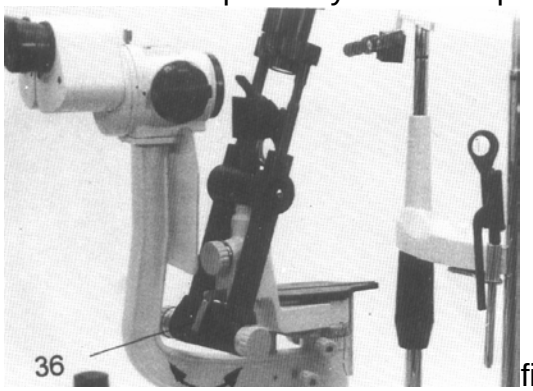


fig13

Reflecting Mirror
Both short and long reflecting mirrors are included with this slit lamp. Use the long mirror in normal examination. When the angle between the illumination part and the microscope is within 3° to 10°, the examined imaged might be obstructed. In this case, use the short mirror. The short mirror is also used when the illumination part is inclined over 10°.

Filter Selection
Turn the filter selection lever (28) in the horizontal surface to add four different kinds of filters respectively into the illumination pathway. Usually the heat-absorbing filter is used so that the patient may feel more comfortable during long periods of examination (Fig. 14).

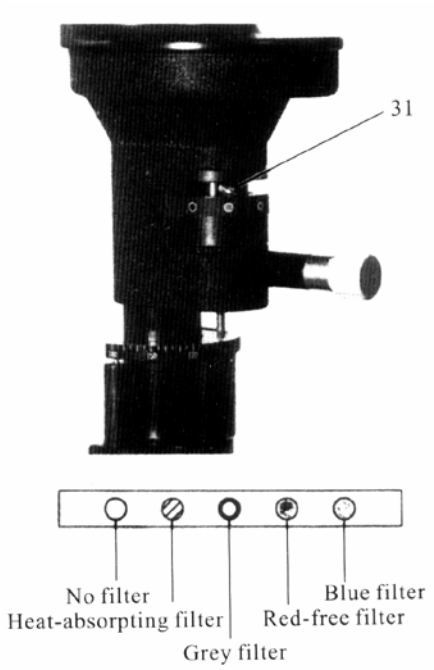


fig14

Fundus Observation with Hruby Lens

During routine usage, observation with the slit lamp is limited within the range from the cornea to the anterior portion of the vitreous body, owing to refraction effects of the cornea and the crystalline lens. With the Hruby lens in front of the microscope, the posterior part of the vitreous body and fundus then can be observed.

Examination Procedure with Hruby Lens:

1. The pupil should be dilated for approximately twenty minutes.
2. Insert the Hruby lens guide plate (15) into the main shaft hole of the illumination and the microscope arm.
3. Pull out the Hruby lens holder from one side of the headrest. Move the Hruby lens holder toward the operator so that it can slide freely to the left and right below the chin rest. Insert the lower end of the Hruby lens lever into the groove on the guide plate.
4. Move the focus of the illumination light and the microscope to the patient's eye.
5. Move the lever to locate the Hruby lens at the center of the visual field and near the patient's eye.
6. Move the lever to focus the Hruby lens at the fundus, then adjust the slit height and width to reduce the unnecessary light in the vision field.
7. To examine different views, either turn the microscope and the illumination arm or change the patient's fixation by manipulating the fixation target.
8. If the long mirror interferes in the examination, replace it with the short mirror.
9. After examination, move the Hruby lens back to the original position on one side of the chin rest.

ATTENTION! Before moving the Hruby lens to the right and left, first have the patient move his head away from the chin rest to avoid hitting the patient's nose with the Hruby lens.

MAINTENANCE

ATTENTION! The replaced waste materials should be treated as industrial waste.

Replacing the Illumination Bulb

Turn the main power switch (8) off. Pull out the plug connected to the lamp house. Rotate the lamp cap (26) counter clockwise and pull it out from the illumination part (A). Take out the old bulb and replace it. The groove in the bulb fixation disc should be aimed at the flange of the lamp base; otherwise the illumination may be uneven. Place the lamp cap in the original position and rotate it clockwise. Then insert the connecting plugs. Turn on the main power switch and assure that the new bulb works.
ATTENTION! The old bulb is hot.

Replacing the Reflecting Mirror

Set the angle between the microscope and the illumination arm to exceed 30°. Incline the illumination arm by more than 10°. Remove the long mirror by holding the extended surface. Insert a new long or short reflecting mirror. When replacing the short mirror, push the bottom of the mirror by using an object with a sharp end

Replacing the Fuse

Turn off the main power switch (8) and pull out the input cable from the power socket. Screw off the fuse holder cover with the screwdriver (X). Replace it with a new fuse and then fasten the cover.

ATTENTION! Please select the fuse of the same type, specification, and rating.

Adjusting the Tightness of the Slit Width Knob

If the slit width control knob is too loose, the slit width may be out of control. Loosen the screw on the right knob with the screwdriver (W), and then hold the left knob firmly with one hand, while the other hand rotates the right knob clockwise to adjust its tightness. When it is appropriate, fasten the screw of the right knob firmly again.

Adjusting the Inclination of the Illumination Part

If the inclination mechanism of the illumination part is too loose, fasten the screws on both sides of the pivot point with the screwdriver (U).

Cleaning

1. Cleaning the lenses and mirrors

If any dust sticks on the lenses or reflecting mirrors, brush them with a brush. In case any dust still remains, wipe it off with a soft cotton dipped with absolute alcohol.

ATTENTION! Never scratch with fingers or any other hard materials.

2. Cleaning the slide plate, rail, and shaft

If the slide plate, rail, and shaft are dirty, the vertical and horizontal movement will be unsteady. Wipe them with a clean soft cloth.

3. Cleaning and sterilizing plastic parts

Clean the plastic parts such as chin rest bracket, headrest belt, etc. with a soft cloth dipped in a soluble detergent or water. Sterilize with medicinal alcohol.

ATTENTION! Do not wipe with any corrosive detergent or the surface may be damaged.

TROUBLE SHOOTING GUIDE

Problem	Possible Cause	Solution
No Illumination	The cable is not connected correctly with the power socket.	Connect the power cable correctly.
	The main power switch is on 'O' position.	Place the switch on 'I' position.
	The plug on the power box is loose.	Insert the plug firmly.
	The plug on the lamp cap is loose.	Insert the plug firmly.
	The bulb has burnt out.	Change the bulb.
	The fuse has blown.	Change the fuse.
Slit is Too Dark	The bulb is not assembled properly.	Assemble the bulb properly.
	The filter lever is in the middle or in the grey filter position.	Set the filter lever to the correct position.
	Voltage selector is wrongly set.	Set the voltage selector correctly.
	The reflecting mirror coating is oxidized.	Change the reflecting mirror.
	Too much dust is on the reflecting surface.	Clean the surface with the brush.
Fuse has Blown	Voltage selector is wrongly set.	Set the voltage selector properly.
	The fuse doesn't match specifications.	Replace it with the proper fuse.
Slit Closes Automatically	The slit width control knob is too loose.	Adjust the tightness of the control knob.
Fixation Target is Off	The output plug is loose.	Insert the output plug firmly.

SPECIFICATIONS OF DIFFERENT MODELS
TWO STEP MAGNIFICATION

BINOCULAR MICROSCOPE	
Eye Pieces	10x, 15x
Objective	1x, 1.6x
Total Magnification	10x, 16x and 24x

ILLUMINATION UNIT	
Slit Image Rotation	0 to 180 degree
Tilting Illumination	5,10,15,20 degree
Filter Disc.	Cobalt Filter, Green Filter, Yellow Filter, Natural density and open aperture
Slit Disphragm Disc	Six apertures of 12, 9, 7, 3 and 0.2mm and a wedge shaped diaphragm fo infinitely variable slit lengths
Halogen Lamp	12 Volt 4.5 Amp

STANDARD ACCESSORIES

15x Eyepieces, Replacing Lamp one piece for illumination unit,
Replacing Mirror,Hruby Lens,Plastic breath shield,Testing Rod,
Dust Cover and Fuse

ZOOM MAGNIFICATION MODEL

BINOCULAR MICROSCOPE	
Microscope	Galilean type
Magnification Change	Continuous Zoom
Total Magnification	10x to 50x

ILLUMINATION	
Slit Image Rotation	0° to 180°
Tilting Illumination	5° to 20°
Filter Disc.	Cobalt Blue, Red Free, Natural Density, & Open Aperture Diaphragm for infinitely variable slit lengths.
Slit Disphragm Disc	Six apertures of 12, 9, 7, 3 and 0.2mm and a wedge shaped diaphragm fo infinitely variable slit lengths
Halogen Lamp	6 Volt 20 W

STANDARD ACCESSORIES

Replacing Lamp one piece for illumination unit,
Replacing Mirror,Hruby Lens,Testing Rod,
Dust Cover and Fuse

OPTIONAL ACCESSORIES

Motorized Table/Manual Table, Beam splitter module with CCD attachment, CCD Camera, Imaging System, Applanation Tonometer.

STEPPER MAGNIFICATION MODEL

BINOCULAR MICROSCOPE	
Viewing Oculars	Binocular, Galilean type
Magnification Change	Three steps magnificatin 10x, 20x, 40x

Eyepieces	Wide field 10x, 15x
Total Magnification	
-WF 10x eyepieces	10x., 20x, 40x
-WF 15x eyepieces	15x, 30x, 60x

ILLUMINATION UNIT	
Slit Image Rotation	0 to 180 degree
Tilting Illumination	5° to 20°
Filter Disc.	Cobalt Blue, Red Free, Natural Density, & Open Aperture Diaphragm for infinitely variable slit lengths
Slit Disphragm Disc	Six apertures of 12, 9, 7, 3 and 0.2mm and a wedge shaped diaphragm fo infinitely variable slit lengths
Halogen Lamp	6 Volt 20 W

STANDARD ACCESSORIES

Replacing Lamp one piece for illumination unit,15x Eyepieces
Replacing Mirror,Hruby Lens,Testing Rod,
Dust Cover and Fuse

STORAGE

Recommended ranges
Temperature range within -40°C to +70°C
Relative humidity range within 10% to 100%
Atmospheric pressure range within 500 to 1060hPa

ZABBYS reserves the right to improve products and literature at any time without obligation to add such improvements to previously manufactured products or literature.

Circuit diagrams, component lists, calibration information and all other necessary information for parts designated can be changed without prior notice or shown in the user manual. All models may have slightly different looks than shown on the figure. The figures are for reference and can be changed without prior notice.

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USAGE OF THE PRODUCT A BRIEF DESCRIPTION

The use of the slit lamp biomicroscope in optometric practice is now more widespread than ever before. Increasing contact lens work and practitioner confidence in advanced examination techniques, such as indirect ophthalmoscopy and contact tonometry, has meant more extensive use of the slit lamp during a routine eye examination. However, without regular use, many of the skills required to use the instrument for successful ocular assessment can be lost, along with practitioner confidence.The aim of this article is to help the practitioner develop good slit-lamp technique, concentrating on the practical application in routine eye examinations.

Focusing the instrument

The most accurate method of doing this is using the focusing rod supplied with the instrument.Place the rod in its pre-determined slot in the central pivot of the instrument with the flat surface facing towards the eyepieces. Remove any spectacles as moving closer to the instrument allows a greater field of view (unless the practitioner has a high degree of astigmatism which could lead to image distortion). 5

To increase accuracy and reduce accommodative fluctuations 'rack out' both eyepieces so they are at maximum plus and therefore giving a 'blurred' image of the focusing rod. Starting on approximately X10 magnification, look through ONE eyepiece at a time and adjust it gradually until a sharp image of the slit just comes into focus. Do not over-adjust the eyepiece as this will increase the likelihood of accommodation (instrument myopia) and may result in fluctuations of image clarity during patient examination. Some eyepieces have a built-in refractive error correction marked on them but for maximum accuracy do not simply adjust the eyepiece to the known refractive error as this does not take into account proximal accommodative changes and therefore is deemed to give a less accurate end point.

Repeat the process for the second eye

Once two clear monocular images are obtained, increase the slit lamp magnification to approximately X24-X32 and fine-tune the focus of each eyepiece in turn. The purpose of this step is to further increase the accuracy of the end point.

Obtaining a binocular single-vision image

Only when two clear monocular images of the slit have been achieved should the eyepieces then be adjusted to give a binocular single view. The eyepiece construction allows for the distance between both eyepieces to be modified to reflect the interpupillary distance of the user. A sharply defined single image of the slit should be seen.

An alternative method of focusing the instrument has been suggested and in the absence of a focusing rod may be used. However, this method is considered to be less accurate than using the focusing rod which consists of a flat plane which slots into the instrument at the point where the two main systems of the slit lamp met – the central pivot. The most commonly used alternative method is using the patient's eyelid6 instead of the focusing rod but this relies on the patient remaining very still as any inadvertent movements will result in the slit lamp no longer being precisely focused.

The eyelid is not a flat plane but a curved surface (not situated exactly at the point of common focus) therefore only that particular point will be in focus at any one time.

To carry out this alternative method, follow the steps detailed above for monocular focusing only to ensure image clarity move the slit lamp backwards and forwards while oscillating the illumination column from side to side until the point at which the slit beam does not move off the eyelid but remains at the focused point. If a 'with' movement is seen, the instrument is within the focus (that is, too close). To correct this the instrument needs to be pulled back towards the practitioner. If an 'against' movement is seen the instrument is outside the focus (ie too far away) so this can be corrected by moving closer to the patient.

Check the slit lamp is coupled

For the Haag-Streit design, ensure the large knob on the front of the illumination column located approximately halfway down is tight. On attempted rotation of the illumination column around its base, the slit remains focused on the focusing rod as it is locked in position, allowing the observation system and illumination system to stay focused at the same point. On rotation of the illumination system relative to the observation system (altering the angle between the two) the image of the slit should remain in the centre of the focusing rod. A slight increase and decrease of the slit width may be observed, but essentially the slit position should remain unaltered if the instrument is coupled. For the Haag-Streit design the vertical adjustment of the illumination column should also be locked to avoid unwanted tilting of the light source away from the focusing rod during setup and use. To check this, gently attempt to rock the illumination column back and forth in the vertical plane – if it remains at 90 degrees then the lock is in operation and the instrument is fully coupled.

Patient Instructions

In order to maximise information gathering during a slit lamp routine it is important to explain the procedure to the patient before beginning to ensure their understanding and cooperation and to allay any fears they may have about the examination.

Patient Setup

A comfortable patient means a cooperative patient!

◆ Adjust patient's chair height

◆ Adjust chin rest level either up or down until the outer canthus of the patient's eye is aligned with the outer canthus marker

◆ Ensure the patient is in the centre of the vertical travel of the instrument

◆ Fixation target is often available if required.

Illumination

The different types of illumination commonly used . A practitioner's slit-lamp routine often incorporates many of these. Image quality of ocular structures is influenced by the type of lamp the instrument has (modern instruments usually have a halogen lamp which provide a brighter more even light source than a tungsten one). Controlling the light levels falling on the eye is also an important part of any slit-lamp routine. The most sophisticated method of achieving this is using a rheostat which allows precision delivery of different amounts of light. An alternative method is to use a neutral density filter but this is not as flexible or as fast as the rheostat. Altering the rheostat is often underutilised and undervalued in the course of a slit-lamp examination when subtle changes to ocular structures can be missed.

By controlling the amount of light falling on the eye the practitioner can minimise any glare from stray light falling on surrounding structures and improve visibility of those structures under observation eg limbal blood vessels. Illumination may also be varied through altering the slit width and height.

Slit-Lamp Manipulation

Familiarity with the slit lamp will enable the practitioner to develop the most efficient and informative routine. For both instrument designs the simplest method of manipulating the controls is to place one hand on the joystick to control the movement of the instrument in three dimensional space, namely horizontally, vertically and forwards/backwards. The other hand should be placed on the illumination column, initially on the slit width knob to allow for adjustments to this and additionally the slit height, the use of filters, adjusting the angle between the eyepiece and illumination systems, manipulating the patient's eyelids and so on during the routine. It is usually easier to reach around the instrument from the temporal side of the patient, meaning that when examining the patient's right eye the practitioner's right hand should be on the joystick and their left hand on the illumination column. This arrangement should then be reversed when examining the patient's left eye.

Every patient is different and therefore the main emphasis during a slit-lamp routine may not necessarily be the same each time. With this in mind it is important to tailor the slit-lamp examination to the patient's needs. It is beyond the scope of this article to cover all applications of the slit lamp in detail but the following generic routine and application of slit-lamp techniques should provide a suitable level of guidance for any practitioner hoping to improve their skills.

General Overview

Setup:

- ◆ Diffuse or wide beam
- ◆High intensity if using a diffusing filter, otherwise a moderate to low intensity
- ◆ Wide and variable angle
- ◆ Low magnification
- ◆Observation unit central and normal (at 90 degrees) to the cornea.

The purpose of this initial step is to ascertain the condition of the patient's ocular features and to highlight any particular areas which require further investigation. It is also useful for ocular photography and CL fit assessment.

There are two commonly used methods of doing this: the first is achieved with the use of a ground glass filter found on the reverse side of the mirror on the illumination system (not all slit lamps have this feature). The use of the diffusing mirror allows a

wide beam and high level of illumination to be used (to counteract the diffusing properties of the mirror).
The second method, where there is no diffusing filter available, is to open the slit as wide as possible and REDUCE the illumination by adjusting the rheostat (the neutral density filter may be used instead if there is no rheostat). Too much light in this instance will result in an uncomfortable patient and may create lots of glare and reflections which obscure the practitioner's view of the patient's eye. Apart from this it is important to remember that with the more modern slit lamps the intensity of the lamp is high and prolonged exposure to it may cause irreversible damage to the ocular tissue.

Using either of the suggested setups, begin examining the patient's eye by scanning across either the upper lid or lower lid tempro-nasally or naso-temporally, varying the angle between the illumination column and microscope during the scan. Either raise or lower the slit lamp and repeat the procedure across the middle of the eye, taking in the appearance of the conjunctiva and cornea while the patient is looking straight ahead. One further scan is recommended at this stage to examine the remaining eyelid. During this time it is recommended that the practitioner has a good look at the eye in situ. This technique highlights any areas which may require further investigation and gives an overall impression of the health of the ocular structures. This procedure is then repeated, only this time the practitioner asks the patient to change their direction of gaze in order to assess more of the ocular surface. Any abnormalities or features should be noted.

Detailed Examamination of the Lids and Lashes

Setup: ◆ Wide parallelepiped beam

◆ Moderate intensity

◆ Wide and variable angle

◆ Low-medium magnification

◆ Observation unit central and normal (at 90 degrees) to the cornea.

Once the general overview has been done, a more detailed look at the lids and lashes should be carried out. The slit beam should be narrowed slightly and the intensity adjusted so it is of medium brightness. Again the angle between the illumination system and the eyepieces is variable, around the 40-70 degrees mark. The magnification should be low to medium. As the practitioner scans across the surfaces of the eyelid using direct illumination, the lid position, any lumps or bumps, lid margin regularity and colour should be assessed along with the meibomian glands and lash follicles. Manipulation of the lids should allow the patency of the glands to be assessed through gentle squeezing. The integrity and position of the puncta can also be checked at this time. Meibomian gland dysfunction may be graded

Detailed Examination of the Conjunctiva and Sclera

Setup:

- ◆ Wide parallelepiped beam
- ◆ Moderate intensity
- ◆ Wide and variable angle
- ◆ Low-medium magnification
- ◆ Observation unit central and normal (at 90 degrees) to the cornea.

Using a similar setup to that for examining the lids and lashes, the conjunctiva can be assessed. Any hyperaemia, degenerative changes such as pingeculae or pigmentation should be noted and where relevant the extent of the change and location eg diffuse, sectorial or focal, using the CCLRU grading scale11 or Efron's grading scale12 to help differentially diagnose any ocular condition. The view of any hyperaemic changes can be enhanced with the red-free filter (green filter) which cuts out any background light scatter, increasing the contrast between the conjunctival tissue/white sclera and the blood vessels which show up 'black'. Gentle movement of the transparent conjunctival membrane can be achieved through lid margin manipulation. The more anterior conjunctival blood vessels will move with the conjunctival tissue across the surface of the sclera, while the deeper scleral vessels stay in situ. A colour variation between the vessels will also be seen under white light, where the deeper scleral vessels tend to have a purplish-blue hue compared to the reddish-pink superficial conjunctival vessels.

Tear FilmAssessment (White Light)

Setup:

- ◆ Horizontal narrow beam/Reduced height vertical beam
- ◆ High intensity
- ◆ 40 degree angle (variable)
- ◆ Low-medium magnification
- ◆ Observation unit central and normal (at 90 degrees) to the cornea.

The slit lamp can be used to evaluate volume and quality of tears. Tear volume can be assessed by measuring the 'tear prism height'. To do this the slit beam can either be rotated through 180 degrees so that it is now horizontal and the slit width reduced to match the tear film volume along the lower lid. The 'height' can then be read off the slit width scale. Alternatively, with the slit beam at 90 degrees, the slit height can be reduced until it just matches the height of the tear prism and again the volume in millimetres can be read off the slit height scale. The normal height of the tear prism is usually considered to be between 0.2 and 0.4 mm. The regularity of the tear prism should also be examined. Tear quality can be ascertained through direct illumination and, on asking the patient to blink, any debris or the degree of oiliness of the tears can be seen as the film moves across the ocular surface. An idea of how well the tears perform in terms of the wettability of the ocular surface can also be gained from this.Tear film assessment may also be carried out using specular reflection. The front surface of the eye acts like a mirror when a certain optical condition is met: the angle of incidence (i) = the angle of reflection (r). In practical terms it is often easier to

create the specular reflection effect using a natural phenomenon known as the 'Purkinje images'. There are four such images of the slit lamp filament which coincide with four of the ocular surfaces of the eye . To assess the tear film a bright image of the lamp filament is seen (Purkinje 1) at the junction of the tears/front surface of the cornea when the angle between the two systems meets the optical criterion.

The practitioner looks for the first Purkinje image by subtly adjusting the separate of the two systems until a clear image of Purkinje 1 is seen down ONE eyepiece. This should be down initially under low-medium magnification with a narrow beam of reduced height and once clear the magnification should be increased to obtain greater detail of the image. Any debris will show up very brightly, moving in the tears and the quality of the tear film may be considered poor if coloured fringes are seen around the Purkinje image. Further tear film assessment with fluorescein and invasive tear break-up time (non-invasive tear break-up time can be measured using the mires on a keratometer but is not discussed here) should be left until the end of the routine once the white light examination is complete.

Corneal Overview

Sclerotic scatter –coupled technique

Setup: ◆ Vertical narrow beam

◆ High intensity

◆ 40-60 degree angle

◆ Naked eye

◆ Instrument coupled.

Sclerotic scatter utilises the principle of total internal reflection15 to create a characteristic ring or glow around the limbus of a healthy cornea. Any breach in the corneal structure will result in the loss of this total internal reflection due to a change in the refractive index of the corneal layers and present itself as a bright area or patch within an otherwise 'dark' cornea because of the light scattering effect.This is observed using indirect illumination because the area where the light source is directed differs to that under observation.A thin beam (optic section) of light (reduce slit height to avoid glare from the bright white scleral surface) is shone onto the limbus, usually from the temporal side.A wide angle, high intensity and low magnification should be used and the instrument is COUPLED.The practitioner may choose to observe the result down the microscope (although this is usually considered less accurate16) or look around the side of the instrument with the naked eye at the patient's cornea to see the resultant limbal glow.Alternatively, when wanting to examine tissue integrity under higher magnification with emphasis on the central corneal area, a different slit lamp setup is required:

Sclerotic scatter – decoupled technique

Setup: ◆ Vertical narrow beam
◆ High intensity
◆ 40-60 degree angle
◆ Med-high magnification
◆ Instrument decoupled
◆ Observation unit central and normal (at 90 degrees) to the cornea.

Any lights in the consulting room should be fully extinguished. Initially, the instrument should be coupled. Focus the instrument under low magnification with a high intensity, narrow beam on the area to be observed eg corneal apex.While this area is sharply in focus lock the instrument in place using the locking screws on the instrument base. Decouple the instrument (refer to the section on slit lamp design). Rotate the illumination column manually until the light just hits the limbus. Continue observing the corneal apex through the eyepieces. The magnification may now be increased to aid observation of any opacities, corneal tissue irregularities and so on.

Examination of the Anterior Chamber Angle

When a patient presents for a routine eye examination, one of the measurements often taken is that of the anterior chamber angle; this is almost certainly required prior to instilling a mydriatic. To accurately assess this, gonioscopy is the best method but this is not routinely carried out in high street practice and it requires addition skill and training. Instead the practitioner relies on a commonly used grading system named after Van Herick, the devisor of the technique. It is accepted that this technique is less accurate than gonioscopy 232as it is an indirect assessment of the angle (qualitative)17 but if carried out routinely using the following setup it gives a good indication of the width of the angle and therefore any potential problems.

VanHerick Technique

The aim of this measurement is to assess the width of the angle using the slit width as it shines directly on the corneo-limbal junction.

Setup: ◆ Thin vertical (90 degree) beam (1-2mm)
◆ High rheostat intensity
◆ Medium magnification (X16)
◆ Angle 60 degrees – lock slit lamp to maintain separation angle
◆ Observation system central and normal to the cornea.

Ask the patient to look down the observation system and move the illumination system to temporal limbus so that it creates a sharp image on the limbus-temporal cornea at 60 degrees. Lock the observation system to the illumination column to maintain the 60-degree separation.

When assessing the temporal angle the image created with direct illumination on the corneo-limbal junction lies most temporally. A dark area, or 'gap' will be observed more nasally to the observer and more nasally again there will be a reflection off the iris (retroillumination).The measurement is based on the apparent width of the sharp focused image (the most temporal image) compared to the gap (which represents the optically empty anterior chamber). Van Herick developed a grading scale which is commonly used in practice to record this. Any angle measured as Grade 2 or less should be viewed with suspicion as it represents a narrow angle which can be a risk factor for the development of closed-angle glaucoma. The main cause of errors and therefore overestimation of the angle is due to the practitioner allowing

the slit lamp to travel too far towards the corneal midline ie too far 'in' from the corneo-limbal junction. By moving too far across the angle will be overestimated as the anterior border. This anatomical variation means that usually the nasal anterior chamber angle tends to be wider. If the temporal angle appears to be narrow then the practitioner should measure the nasal angle too. The setup for this is the same as for measuring the temporal angle only the illumination system should be moved so that light is directed from the nasal side onto the nasal corneo-limbal junction. If the patient has larger facial features (for example, a prominent nose) which obscure the light, this problem can be resolved by ensuring the separation angle between the illumination column and observation system is locked at 60 degrees, then swinging the entire locked system towards the temporal side – ask the patient to look keep looking down the observation system as it is rotated temporally. Adjust the slit lamp to ensure the light just bounces off the nasal corneo-junction and measure the angle as before based on Van Herick's grading scale.

Smith'sTechnique

Some authors suggest that a more accurate assessment of the risk to a patient of developing closed-angle glaucoma is a measurement of the anterior chamber depth as it is a quantitative method. Certain eye conditions may lead to a change in the depth of the anterior chamber over time, for example, development of cataract can led to a bowing forward of the iris due to the increased mass of the lens, resulting in a shallowing of the chamber. There is evidence to suggest that a patient may have a narrow anterior chamber angle but still have a relatively deep anterior chamber. It is not possible, apart from using gonioscopy, to view the iris insertion but anterior chamber depth can be assessed using 'Smith's technique' which is a quantitative measurement.

Setup: ◆ Thin horizontal (180 degrees) beam (1-2mm)

◆ High rheostat intensity

◆ Medium magnification (X16)

◆ Angle 60º – lock slit lamp to maintain separation angle

◆ Observation system central and normal to the cornea

◆ Patient's right eye examined with right eyepiece on the observation system.

Direct a narrow, high intensity beam onto the cornea. Two horizontal images of the light are seen – one reflecting off the corneal epithelium and the other off the anterior lens/iris. A gap between the two images will be seen. By increasing the slit height adjustment until the two image are seen to just touch, a measurement can be taken. Read this measurement off the slit height scale and use Table 9 to convert this into an anterior chamber depth measurement.For those instruments without a variable slit height adjustment a modified Smith's technique may be used where the angle of the illumination system and observation system is gradually reduced until the two images are just touching. Clinically an anterior chamber depth of 2mm or less should be treated with suspicion. A new technique for non-invasive measurement of the anterior depth has recently been developed using a scanning peripheral anterior chamber depth analyser.

Generally, it is appropriate to examine areas either side of the corneal midline with the illumination system on the same side as that which is being examined. So for temporal cornea the illumination system should be positioned on the temporal side of the observation system, and for nasal cornea it should be on the nasal side.1 However, this does not have to be strictly adhered to as one of the major advantages of the slit lamp is its versatility. The movement of the coupled system around a

central pivot offers the flexibility to manoeuvre the illumination system relative to the observation system. This allows the practitioner to refine and simultaneously employ more than one technique.

Parallelepiped

Setup:

- ☐ Vertical beam 2-4mm wide
- ☐ High intensity
- ☐ 40-70 degree angle
- ☐ Med-high magnification
- ☐ Instrument coupled.

Corneal examination should be carried out with direct illumination and a parallelepiped setup. This allows a good quality three-dimensional image of the corneal layers . epithelium, stroma and endothelium (and the limiting borders between each) . to be viewed. The wider the angle, the greater the separation of the structures and, therefore, the easier it is to differentiate them.

The initial magnification should be medium, and then if necessary increased to closely examine any areas requiring further investigation. The cornea should be scanned systematically using this technique.

Optic section

Setup:

◆ Vertical beam 1-2mm wide
◆ High intensity
◆ 20-60 degree angle
◆ Med-high magnification
◆ Instrument coupled.

Any corneal abnormalities detected while using the parallelepiped technique need to be accurately examined. One of the most important decisions with regard to this is to determine the location of any lesion, that is, the depth.To do this, a modified version of the parallelepiped is adopted – the optic section. The slit width is narrowed to a 'knife edge' (1-2mm) and the rheostat setting turned to maximum intensity. This gives a very bright, thin, sharp slit within which a high quality 'slice' of the corneal tissue can be seen.The magnification should be high and the angle between the illumination system and the eye-pieces increased to around 60 degrees.

The difference in the refractive index of each corneal layer changes the property of the light as it passes through them resulting in a high resolution image of each. Apart from showing the depth of any foreign body or lesion this also gives a good indication of the regularity of the corneal curvature showing any areas of thinning (ectasis) or protuberance.

Further investigation of the cornea

In contact lens work or certain ocular conditions, such as pigment dispersion syndrome or the presence of keratic precipitates, it is important to take a close look at the corneal endothelium. More than one technique may be used to do this.

Specular reflection

Setup:

- ☐Vertical, reduced height beam 2-3mm wide
- ☐High intensity
- ☐Incidence angle = reflection angle
- ☐Med-high magnification

- ☐ Instrument coupled.

Specular reflection has already been mentioned in the section on tear film assessment in Part 1. To examine the endothelium in this way the slit lamp should be set up in a similar fashion to that used for examining the tear film, except the instrument should be focused on Purkinje image IIII, located on the back surface of the cornea . the second most anteriorly placed image of the filament bulb. The corneal section will be slightly out of focus initially.Under medium magnification with a slit width of 3-4mm (parallelepiped), the angle is then narrowed between the illumination column and the eyepieces until the section lies almost on top of Purkinje I and IIII. At this point, a dull greyish area can be seen to the nasal side of the section. This area represents a tiny snapshot of the endothelial layer which is small and limited by the size of the filament image. Most slit lamps do not offer high enough magnification to see the individual cells which make up the endothelial structure (around 80X is required to see this). Some slit lamps have a maximum magnification of around 40X which gives some idea of the integrity of the endothelium, showing up any anomalies in the structure such as polymegathism or polymorphism. This manifests as areas which appear optically empty to the practitioner; these areas do not equate to 'missing' cells but rather are due to the irregularity of the endothelial layer at this point.
When cells become damaged the surrounding cells adapt in terms of their size and shape to repair the endothelium. Any consequent irregularity created by this process means that the endothelial surface can no longer act as a mirror. The light striking these areas is not reflected back down the observation system but instead bounces off these irregular cells in different directions resulting in the observer having the impression they are seeing a 'gap' where this has occurred.

Retroillumination
Setup:

- ☐Vertical beam . parallelepiped (may vary)
- ☐Med-high intensity
- ☐20-60 degree angle
- ☐Low-high magnification
- ☐Instrument coupled or decoupled.

This illumination technique relies on using light bouncing off a structure located more posteriorly to that which is under observation. One such ocular structure used to create this setup is the iris, another example of such an object is the fundus.
Some of the light which falls onto the iris is diffusely reflected back towards the observer and in doing so illuminates any structures sitting more anterior to it, such as the cornea.This technique is known as retroillumination. This type of illumination can be carried out with the instrument either 'coupled' or 'decoupled' depending on the location of the object under observation. For those areas of interest lying close to the limbus and, therefore, closer to the iris it is possible to examine this when the instrument is coupled, under low magnification. This is known as 'direct retroillumination'. This technique improves contrast and allows any subtle changes to be seen in this diffuse light without unwanted reflections obscuring the view.
Alternatively, if the area of interest lies more centrally or higher magnification is required, then the instrument needs to be decoupled to ensure that the area under observation is sharply in focus.
By focusing the coupled instrument on the area under examination, the observer should then decouple the illumination system and manipulate it so that the light hitting the area of interest now bounces off a posterior region to the side (not directly behind it) of the structure being assessed. This allows the structure to be observed against a dark background and this method is known as 'indirect retroillumination'.

The observation system should remain focused and locked in the original position. A combination, therefore, of direct, indirect and retroillumination is required to fully assess all aspects of the cornea.

Examination of the limbal vessels

Indirect illumination
Setup:

- Vertical beam . parallelepiped (may vary)
  - Med-high intensity
  - 20-60 degree angle
  - Low-high magnification
  - Instrument coupled.

Limbal vasculature can be hard to assess using direct illumination . vessel location relative to the higher contrast cornea and white sclera means that differentiating the limbal detail can be difficult due to the bright reflection and glare off the surrounding tissue.To counteract these problems, the easiest method is to use indirect illumination. The slit height can be lowered to help reduce unwanted reflections and glare from the adjacent tissues. Using this set up to examine, for example, nasal limbal vessels, the illumination column can be moved to the nasal side, the same side as that being assessed. This further reduces unwanted reflections further and with the beam forming a clear image of nasal cornea light on either side of the bright image shows up as a greyish glow in which the limbal vessel arcade can be seen along with any vascular changes which may be found, for example, with contact lens induced hypoxia. The vessels are difficult to see and this technique requires practice to master. To enhance the image the red-free filter can be used to improve the contrast and increase the magnification to give a more detailed examination.The vessels should be assessed around the entire limbus as localised changes may be apparent.

Anterior chamber assessment

Assessment of the dimensions of the anterior chamber is important but as part of a slit-lamp routine any anterior chamber activity should also be noted.
Certain eye conditions may present with anterior chamber activity or evidence of previous episodes of anterior chamber inflammation such as those found with anterior uveitis. The anterior chamber is normally an optically empty space which allows light to pass straight through it as it does not contain anything for light to reflect off. Anterior chamber activity may present with characteristic features such as cells and flare which the practitioner can assess in a number of ways using the slit lamp.

Conic section

Setup:

- ◆ Room background illumination completely off
- ◆ Narrow circular beam
- ◆ High rheostat intensity
- ◆ Medium-high magnification (24X-33X)
- ◆ Angle 45 degrees
- ◆ Observation system central and normal to the cornea.

The conic beam should be initially focused on the front surface of the cornea, and the instrument then moved forward until the focus is directed halfway between the cornea and the lens behind, so that both structures are equally out of focus.

A quiet anterior chamber will show a dark space in between the two blurred images of the cornea and the lens. Any activity such as flare and cells will show up in the beam of light projecting across the anterior chamber as grey 'mist' with white cells moving within it illuminated in the beam. The cells and flare show up due to the Tyndall effect- when the light strikes these objects in the anterior chamber the light is scattered and reflected back down the observation system.
Oscillating the slit-lamp system back and forth allows the visibility of the cells and flare to be increased using a combination of direct and indirect illumination. To further increase visibility of any objects in the anterior chamber ask the patient to look up and then straight ahead as this causes the contents to move around and settle back down under the influence of gravity, stirring up any objects of interest which may then show up within the light beam.

Grading cells and flare
Setup:

- ☐ Room background illumination completely off
- ☐ 3mm high by 1mm wide parallelepiped
- ☐ High rheostat intensity
- ☐ Medium-high magnification (24X-33X)
- ☐ Angle 45-60 degrees
- ☐ Observation system central and normal to the cornea.

It is useful to measure the degree of anterior chamber activity using a known grading system. The number of cells visible within the light beam should be counted and graded accordingly.

reference and can be changed without prior notice.

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